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MODULAR SIMULATOR SYSTEM (MSS)

SYSTEM/SEGMENT SPECIFICATION FOR THE GENERIC
MODULAR SIMULATOR SYSTEM - FLIGHT CONTROLS
MODULE VOLUME 3



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AUGUST 1993

FINAL REPORT

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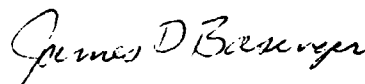
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PREFACE

This generic Modular Simulator System (MSS) segment specification has been developed in accordance with DI-CMAN-80008A, Data Item Description for System/Segment Specifications. This specification meets or exceeds the requirements for MIL-STD-490, Type A, specifications. This specification is designed to be tailored to specify the requirements for a specific aircraft training device or family of aircraft training devices. Training devices may consist of Weapons System Trainers (WST), Operational Flight Trainers (OFT), Cockpit Procedures Trainers (CPT), Part Task trainers (PTT), etc.

Tailoring will be necessary to meet specific application requirements. The tailoring must be accomplished so as not to violate the goals and intent of the MSS concept. It is assumed that the user of this document has a familiarity with the MSS design concepts and architecture, the application aircraft training requirements, and general working knowledge of aircraft training systems. It is suggested that the user read the "Modular Simulator System Engineering Design Guide (D495-10440-1) and the "Modular Simulator System Management Guide" (D495-10439-1 prior to tailoring this specification. These guides provide an overview of the MSS architecture, an in-depth discussion on its application, and lessons learned from previous applications.

Each segment in the MSS architecture provides a portion of the overall system functionality. Similar functions and operations were grouped in each segment based on past experience, areas of design expertise, and management of intersegment communication. To promote reuse of the segments and gain the maximum benefits of using the MSS approach, it is suggested that the user adhere to the generic functional allocation. Interfaces between the segments should remain relatively constant from application to application. The application vehicle is considered to be an aircraft (e.g. fixed wing, variable geometry, or rotary wing), although the MSS architecture and concepts may be applied to either ground or sea vehicles.

This specification contains specific tailoring instructions for each paragraph. The instructions are contained within the paragraphs, and are identified by blank spaces and/or italicized text. When the tailoring process is complete, the italicized tailoring instructions should have been replaced by application specific text or deleted from the specification. Paragraphs which do not apply to a particular application should not be deleted. They should be identified as "Not Applicable" to maintain paragraph numbering consistency between volumes and various MSS applications.

1. SCOPE

1.1 Identification. This segment specification establishes the requirements for the Flight Controls segment of the _____ (insert application aircraft type) Modular Simulator System (MSS). This volume is one of _____ (insert number of volumes in the application system/segment specification) volumes which comprise the system/segment specification for the _____ (insert application aircraft type) MSS. Volume I of this specification contains system level requirements such as MSS structure, communication architecture, network interface performance, system level diagnostic and test requirements, Ada programming language applicability, adaptability and expansibility, and other requirements which pertain to all volumes.

1.2 System Overview. The Flight Controls segment provides for the simulation, stimulation, and/or emulation of the control surfaces, control devices, and control systems within the _____ (insert application aircraft type) MSS. The functions of the flight controls provide real-time vehicle control representative of the ownship in performance and feel for normal and degraded operation. Each of the Flight Controls functions identified are processed within the Flight Controls segment.

The Flight Controls segment interfaces with the other MSS segments as described in the _____ (insert application aircraft type) MSS Interface Design Document (IDD) _____ (insert IDD document number). Each of the Flight Control segment functions identified are processed within the Flight Control segment. The Flight Controls segment may require an external interface to a control loading system which applies the simulated forces that the crew member feels on the flight controls due to aerodynamic loads, friction, mass, and elasticity.

The Flight Controls segment receives input from a trainee or aircraft system requesting changes in the position of a flight control and then generates the appropriate feedback to the trainee, sometimes through control loading. The segment models the movement of control surfaces in response to changes in settings of the flight controls. That information is fed to internal models of automatic flight control systems, stability enhancement systems, and trim.

1.3 Document Overview. This segment specification defines unique requirements of the Flight Controls segment to the _____ (insert application aircraft type) MSS. It contains descriptions of the functions performed within the segment including communication interface requirements, segment performance requirements, segment diagnostic and test requirements, and expansibility and adaptability requirements as applicable to the Flight Controls segment.

2. APPLICABLE DOCUMENTS

2.1 Government Documents. The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

The Government documents which are applicable to the entire _____ (*insert application aircraft type*) MSS are listed in Volume I of the system segment specification. The following Government documents are in addition to those documents and specifically applicable to the _____ (*insert application aircraft type*) Flight Controls segment.

SPECIFICATIONS:

Federal - (*Identify applicable federal specifications*)
Military - (*Identify applicable military specifications*)
Other Government Agency - (*Identify applicable government specifications*)

STANDARDS:

Federal - (*Identify applicable federal standards*)
Military - (*Identify applicable military standards*)
Other Government Agency - (*Identify applicable government standards*)

DRAWINGS: (*Identify applicable drawings*)

OTHER PUBLICATIONS:

Manuals - (*Identify applicable manuals*)
Regulations - (*Identify applicable regulations*)
Handbooks - (*Identify applicable handbooks*)
Bulletins - (*Identify applicable bulletins*)

Copies of specifications, standards, drawings, and publications required by suppliers in connection with specified procurement functions should be obtained from the contracting agency or as directed by the contracting officer.

(In this paragraph list only those documents which are explicitly referenced within this specification volume. If a requirement paragraph is tailored to reference a system/segment specification VOLUME I paragraph, and that paragraph contains a reference, the document should not be listed here. All requirements and references in system/segment specification Volume I are requirements of this specification unless specifically excluded in this volume.)

2.2 Non-Government Documents. The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

The non-Government documents which are applicable to the entire _____ *(insert application aircraft type)* MSS are listed in Volume I of the system/segment specification. The following non-Government documents are in addition to those documents and specifically applicable to the _____ *(insert application aircraft type)* Flight Controls segment.

SPECIFICATIONS - *(Identify applicable non-government specifications)*

STANDARDS - *(Identify applicable non-government standards)*

DRAWINGS - *(Identify applicable non-government drawings)*

OTHER PUBLICATIONS - *(Identify applicable non-government publications)*

Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal Agencies.

(In this paragraph list only those documents which are explicitly referenced within this specification volume. If a requirement paragraph is tailored to reference a system/segment specification Volume I paragraph, and that paragraph contains a reference, the secondary document should not be listed here. All requirements and references in system/segment specification Volume I are requirements of this specification unless specifically excluded in this volume.)

3. SEGMENT REQUIREMENTS

3.1 Segment Definition. The Flight Controls segment is one of _____ (insert number of segments used by the application simulation) unique segments which comprise the _____ (insert application aircraft type) MSS. The Flight Controls segment shall provide the modes, states, and functions as defined in this specification volume and Volume I.

The Flight Controls segment shall provide real-time emulation of the _____ (insert application aircraft type) MSS flight control positions and forces, control surfaces and control devices/systems. It shall include the simulation of primary controls, secondary controls and automatic flight controls.

(This paragraph should be tailored to convey the exact top level functions required of the segment. If this segment is to be used/reused on several devices within a family of trainers, that should be stated here with any unique performance requirements.)

3.2 Characteristics.

3.2.1 Performance Characteristics. Performance of the Flight Controls segment shall be as specified herein and in accordance with the _____ (insert application aircraft type) design criteria. The Flight Controls segment shall simulate functions associated with the _____ (insert application aircraft type) MSS control system and control surface operations. The fidelity of the Flight Controls segment shall be sufficient to support the required level of training as specified in Volume I, paragraph 6.1 of this specification.

(Additional text should be added to this paragraph to identify design criteria. A general statement with respect to the fidelity of the simulation should be added.)

3.2.1.1 Segment Modes and States. The Flight Controls segment shall support the modes and states as described in Volume I of this specification. Additional requirements, or operations specific to the Flight Controls segment shall not cause degradation of the system or violate the intent of the system mode or state.

(Introduction of new modes is prohibited. Functions should be accomplished within the established modes and states. This paragraph should be tailored to describe the segment's specific response to a given mode or state. Subparagraphs should be added to identify and define unique segment requirements for each mode and state.)

3.2.1.1.1 Training Mode Alignment State. During the training mode alignment state, the Flight Controls segment shall trim the simulated flight controls, in all axis. This shall be accomplished to avoid sudden inappropriate Flight Controls, which

otherwise might occur, when the simulator is returned to the training mode run state.

3.2.1.1.1.1 Primary Controls Alignment. In the training mode alignment state, the Flight Controls segment shall align all primary controls surfaces to a position which allows smooth and stable flight following release from the training mode freeze state. In the training mode freeze state, the primary controls function shall keep all surface positions at the position they were in when freeze was initiated except when an alignment is requested.

(This paragraph should contain a list of alignment requirements for the Primary Controls Function.)

3.2.1.1.1.2 Secondary Controls Alignment. In the training mode alignment state, secondary controls, (i.e. flap handle and landing gear handle) shall be capable of manual alignment by the student prior to release from the freeze state. The Flight Control segment shall provide to the IOS segment for display, the required secondary control positions for each of the secondary controls.

(This paragraph should contain a list of alignment requirements for the Secondary Controls Function. These requirements should include all secondary flight controls that are not loaded and require the student to move the control to the desired position.)

3.2.1.1.1.3 Trim Alignment. In the training mode alignment state, the trim function shall trim all primary flight controls to the appropriate position as demanded by the reposition function, prior to release from the alignment mode freeze state. In the training mode freeze state, the trim function shall maintain any existing trim commands.

(This paragraph should contain a list of alignment requirements for the Trim Alignment Function.)

3.2.1.1.1.4 Hinge Moment Alignment. In the training mode alignment state the value of the hinge moment function shall fall out of the calculation as a result of the trim function and should not require separate alignment requirements.

(Normally there should not be any unique alignment requirements for the hinge moment function)

3.2.1.1.1.5 Automatic Flight Controls System Alignment. In the training mode alignment state, the Automatic Flight Control System (AFCS) function must be aligned to a position indicative of a parked aircraft (i.e., AFSC disengaged).

(For this requirements, it must be noted that the MSS may not safely transition from freeze to run state if the AFCS remains engaged during alignment. Parameter changes that affect the dynamic pressure of the aircraft that were changed during the freeze state could cause violent control movements when releasing from the freeze state. Maintaining the requirement that automatic flight controls remain engaged during the freeze state could require complex, costly and time consuming methods of re-alignment.)

3.2.1.1.1.6 Toe Brakes and Anti-Skid Function Alignment. The toe brakes and anti-skid function shall initialize to a condition indicative of a "no braking" command.

(This paragraph should contain a list of alignment requirements for the Toe Brakes and Anti-Skid Function.)

3.2.1.2 Flight Controls Segment Functions. The Flight Controls segment shall provide for a realistic simulation of the flight characteristics of the application aircraft. These characteristics shall include the state of the application aircraft. The following functions shall be accomplished by the _____ *(insert application aircraft type)* MSS Flight Controls segment.

- | | |
|---------------------------------------|--------------------------|
| a. Flight Controls Support Function | Implemented |
| b. Primary Controls Function | <i>(Implemented,N/A)</i> |
| c. Secondary Flight Controls Function | <i>(Implemented,N/A)</i> |
| d. Trim Function | <i>(Implemented,N/A)</i> |
| e. Hinge Moments Function | <i>(Implemented,N/A)</i> |
| f. Automatic Flight Controls Function | <i>(Implemented,N/A)</i> |
| g. Toe Brakes and Anti-Skid Function | <i>(Implemented,N/A)</i> |

(Functions characterized as "Implemented" shall be implemented to the extent described by the paragraphs dedicated to those functions. Functions characterized as "Not Applicable" (N/A) shall not exist in this simulation of the application aircraft and are not required to be implemented in any form within the Flight Controls segment)

3.2.1.2.1 Flight Controls Support Function. The Flight Controls support function shall be responsible for providing the segment-unique support services required for the operation of the Flight Controls segment in the MSS environment. The Flight Controls support function services shall include the functions listed below, and as described in the following paragraphs.

- a. Executive Control
- b. Initialization
- c. MSS Virtual Network (VNET) Communication
- d. Diagnostics and Test
- e. Backdoor Interfacing
- f. Malfunctions
- g. Damage Assessment
- h. Security Processing

- i. Scoring
- j. Other Support Function Services

(Service functions are usually incidental to the simulation but no less critical. Examples are overhead and I/O functions. Additional services may be added as necessary to meet specific application requirements. Corresponding subparagraphs need to be added below. Do not reuse deleted paragraphs.)

3.2.1.2.1.1 Executive Control. The executive control support service shall provide the operational control for the Flight Controls segment. This control shall include execution sequencing of all segment software, mode and state control, and communication between the simulation software and the VNET.

(For most applications this paragraph will require no tailoring. If additional or specific executive control functions are required, they should be identified in this paragraph.)

3.2.1.2.1.2 Initialization. The initialization support service shall control initial hardware and software states for the Flight Controls segment. System initialization shall occur during power-up and system resets, as defined in Volume I of this specification. The initialization function shall also access mission initialization data and transfer the data to other segment functions for mission initialization.

(Initialization requirements unique to the application aircraft Flight Controls segment should be specified in this paragraph. Initialization refers to setting initial hardware and software states during power-up and system resets as defined in Volume I. Instrument scale factors and default instrument settings (usually powered off) are typically initialized by this function. A second initialization function is to access mission initialization data (from disc for example) to pass to other segment functions for mission initialization.)

3.2.1.2.1.2.1 Primary Controls Function. The primary controls function shall initialize all surfaces to the position indicative of a parked aircraft (i.e., alignment to takeoff).

(This paragraph should contain a list of initial condition requirements for the primary controls. The control positions for simulator start up should be specified.)

3.2.1.2.1.2.2 Secondary Flight Controls. The secondary flight controls function shall identify to the IOS segment, for display, secondary (non-loaded) flight controls that must be repositioned by the trainee prior to release of the simulator from the freeze state.

(This paragraph should contain a list of initial condition requirements for the non-loaded secondary controls i.e., landing gear handle, flap handle, wing sweep, etc. Secondary flight control positions for simulator start up should also be specified.)

3.2.1.2.1.2.3 Trim Function. The trim function shall provide that all flight control surface trims are positioned to the position indicative of a parked aircraft (i.e., alignment to takeoff).

(This paragraph should contain a list of initial condition requirements for the Trim function. The trim control positions for simulator start up should be specified. Normally all loaded flight control trims are set to zero at initialization. Non-loaded flight control trims are usually identified to the IOS for display.)

3.2.1.2.1.2.4 Hinge Moments Function. The hinge moment function shall not require an additional alignment process. The value of the hinge moments function shall fall out as a result of the initialized trim condition.

(Normally there should not be any unique initial condition requirements for the hinge moment function.)

3.2.1.2.1.2.5 Automatic Flight Controls System Function. The Automatic Flight Controls System function shall initialize to the position indicative of a parked aircraft (i.e., AFCS disengaged).

(This paragraph should contain a list of initial condition requirements for the Automatic Flight Controls System function. It requires the segment designer to enumerate a list of items (e.g., controls, functions, modes, initial conditions etc.) to establish a baseline for detailed requirements.)

3.2.1.2.1.2.6 Toe Brakes and Anti-Skid Function. The toe brakes and anti-skid function shall initialize to a condition indicative of a parked aircraft with no braking commands applied.

(This paragraph should contain a list of initial condition requirements for the Toe Brakes and Anti-Skid function.)

3.2.1.2.1.3 MSS Virtual Network Communication. The MSS VNET communication support service shall provide the Flight Controls segment interface to the MSS VNET. It shall allow communication with other segments in the _____ (insert application aircraft type) MSS. The Flight Controls segment shall communicate with the MSS VNET in accordance with the protocol requirements defined in the IDD _____ (insert IDD document number).

3.2.1.2.1.4 Diagnostics and Test. The diagnostics and test support service shall provide control for the diagnostic and test functions incorporated into the Flight Controls segment. Diagnostic and test requirements for the Flight Controls segment shall be in accordance with the requirements specified herein.

(Based upon the specific simulator requirements, all or part of the three types of diagnostic capabilities may be required. Not Applicable should be inserted if the specific diagnostic type is

not required for the application MSS. Specific diagnostics and their requirements should be listed in each paragraph when applicable.)

3.2.1.2.1.4.1 On-Line Diagnostics. On-line diagnostics shall be provided for the Flight Controls segment. These diagnostics shall be self initiating during start-up and/or as a background function during training mode.

(On-line Diagnostics are those diagnostics that executed while the training system is in the real-time training mode. These diagnostics may run as a background task. An example that would be used in an MSS environment might be a segment functional diagnostic. Each segment would tell the IOS segment that it is still functioning on a periodic basis (say once a minute). If the IOS does not receive the message then it assumes the segment is not functioning properly and provides a message to the instructor.)

3.2.1.2.1.4.2 Off-Line Diagnostics. Off-line diagnostics shall be provided by the Flight Controls segment. Off-line diagnostics shall be executed when the _____ (insert application aircraft type) MSS is not engaged system in a system mode.

(Off-line Diagnostics are those diagnostics that are performed on a segment in the stand-alone or segment mode. Typical off-line diagnostics would include; hardware self tests, software tests, I/O debug programs, Daily Readiness at a segment level, etc.)

3.2.1.2.1.4.3 Remote Controlled Diagnostics. Remote Controlled Diagnostics shall be provided for the Flight Controls segment. These diagnostics shall be executed from the Instructor Operator Station (IOS) when the MSS is in the Remote Controlled Diagnostic mode.

(Remote Controlled Diagnostics are those diagnostics that run in the special remote controlled diagnostic mode. These diagnostics require the system to be up and running and the segments communicating. An example of a Remote Controlled Diagnostic would be a real-time debugger.)

3.2.1.2.1.5 Backdoor Interfacing. The backdoor interfacing support service shall provide the means to support external interfaces to the Flight Controls segment. All ownship Flight Control system Input/Output (I/O) unless specifically identified in the _____ (insert application aircraft type) MSS IDD shall interface via the MSS VNET. Backdoor interfaces shall not be utilized for normal intersegment communication.

(Specific external interfaces should be identified in this paragraph. Backdoor interfaces may include a 1553 bus to communicate with installed aircraft avionics or a specialized interface to drive a Head-Up Display (HUD). A backdoor interface may not be utilized to transmit intersegment data.)

3.2.1.2.1.6 Malfunctions. The malfunctions support service shall provide the control for the processing and execution of the Flight Controls segment malfunctions. The system response shall be in accordance with the aircraft design criteria.

(The Flight Controls segment malfunctions should be defined in a program unique Malfunction Description Document.

3.2.1.2.1.7 Damage Assessment. The damage assessment support service shall provide for the processing and implementation of any damage simulation for which the Flight Controls segment is responsible. This shall include the degradation of the appropriate systems within the Flight Controls segment based upon the evaluation of the damage severity and location.

(Based upon the training requirements of the application aircraft MSS, any specific damage assessment and system degradation requirements should be specified in this paragraph. i.e., a non-fatal hit by an other-ship weapon causing flight control abnormalities)

3.2.1.2.1.8 Security Processing. The Flight Controls segment security processing support service shall provide processing to meet the security requirements of the _____ (insert application aircraft type) MSS Flight Controls segment.

(This paragraph should be expanded to clearly specify which government directives apply, and to what extent, consistent with security considerations. Security processing would include Memory Erase Mode if required and any other security considerations such as removable memory or special encoding devices.)

3.2.1.2.1.9 Scoring. The scoring support service shall provide the ability to collect specific data for the assessment of a student's performance in his utilization of the _____ (insert application aircraft type) Flight Controls system. The Flight Controls segment scoring data shall be provided to the IOS segment via the MSS VNET.

(Application specific scoring data requirements for the Flight Controls segment shall be listed in this paragraph. If large amounts of data are required, it may be advisable to provide this to the IOS as a non-real-time activity.)

3.2.1.2.1.10 Other Support Function Services. Not Applicable.

(If there are other support functions unique to this segment they should be listed here, otherwise identify this paragraph as "Not Applicable". Intrasegment communication is an example of a function that might be listed in this paragraph. Before defining new functions, be sure the function cannot be incorporated as a variant of an existing function.)

3.2.1.2.2 Primary Controls Function. The primary controls function shall provide the simulation of the control and movement of the primary flight control surfaces. The surface positions shall be determined from the cockpit control device inputs, AFCS inputs, hinge moment data, hydraulic pressures, electrical power, trim inputs, flight condition (attitude, Mach, etc) and malfunction data. The primary controls function shall include the simulation of surfaces such as ailerons, elevators, rudders, canards, stabilators, flaperons, swashplates, rotor blades, and nose wheel steering. This shall include simulation of the artificial feel system and friction, spring forces, deadband and hysteresis appropriate to each control input device inertia, cable stretch, backlash, blowdown, and bob weights. The primary controls function shall determine the positions of primary control surfaces by simulating the linkage to the surfaces including tabs, damping, friction, spring forces, hysteresis and deadband.

The control loading system shall have the following specific dynamic response requirements. The force servo closed-loop response shall be stable and fast enough to provide realistic dynamic feel. Dynamic damping cycles (free response of the flight controls) shall match, within _____ (*insert % of period and damping, normally 20%*) of period and damping, that of the _____ (*insert application aircraft type*). Frequency response of the control loading servos shall demonstrate a control-fixed, closed-loop force within +/- 3 db up to a specified frequency, which is in the range from of _____ Hz to _____ Hz (*normally 30 Hz to 100 Hz*).

The movements of the motion platform may cause unnatural displacements on the cockpit control devices. The primary controls function shall also provide compensation to account for these disturbances. The compensation shall be a function of the motion platform position.

(The following considerations should be addressed concerning the specification of the primary flight control system simulation, based on training requirements:

- a. *Futuristic flight controls required (vectored thrust, variable camber wings, variable tilt nacelles, etc)*
- b. *Class of air vehicle being simulated (rotorcraft, airplane, glider, balloon, etc)*
 1. *If "rotorcraft" which of the following flight controls are being simulated; cyclic, collective, pedals, etc*
 2. *If "airplane" which of the following primary flight controls are being simulated; ailerons, spoilers, elevators, rudders, canards, flaperons, stabilators, elevons, stabilizers, etc*
- c. *Degraded modes of operation, battle damage and/or malfunctions requirements.*
- d. *Primary passive/loadable/drivable controls (roll control, pitch control, yaw control,*

- power and propulsion, etc) required to be used in this simulation*
- e. Primary flight control observables required to be presented to the aircrew (elevator position, rudder position, etc)*

When the application aircraft has loaded controls the control loading system shall drive the primary control input devices (i.e. stick, column, wheel, and pedals) to provide the proper control position and feel for the pilot.

In a low fidelity training application i.e. Cockpit Procedures Trainer (CPT), Maintenance trainer (MT), etc.) spring loaded controls may be satisfactory. High fidelity simulators, i.e. Weapon System Trainer (WST), Operational Flight Trainer (OFT) may require a loaded control loading system to provide control forces, friction, damping, position limits, hysteresis, and deadbands representative of that of the aircraft. The frequency response requirements of the control loading servos should be noted here. The degree of simulation for any fly-by-wire systems or control augmentation systems should be addressed in this paragraph. For applications where a control loading system is utilized, tolerances should be given for all dynamic response parameters such as forces, friction, damping, position, hysteresis and deadbands. FAA Circular AC 120-40 should be used to determine tolerances that will be applied to the flight controls. If a full simulation is required, any performance characteristics less than "as aircraft" should be identified.)

3.2.1.2.3 Secondary Control Devices Function. The secondary control devices function provides the simulation of the positioning of the aircraft's exterior moveable equipment and surfaces which are not considered primary controls.

Secondary control surfaces such as flaps, slats, spoilers and variable swept wings shall be simulated by this function. Equipment such as the landing gear, toe brakes, ram air turbine, arresting hook, and aircraft doors (i.e. landing gear, bomb bay and cargo) shall also be simulated by this function. The normalized positions and states (i.e., open, opening, closed, etc.) of the secondary control devices shall be identified.

(The following considerations should be addressed concerning the specification of the secondary flight control system simulation, based on training requirements:

- a. Class of air vehicle to being simulated (rotorcraft, airplane, glider balloon, etc)*
 - 1. If "rotorcraft" which rotary wing secondary controls are required, swashplates, etc?*
 - 2. If "airplane" which of the following secondary control devices are required?
(landing gear, aircraft doors, slats, speedbrakes, arresting hook, leading edge flaps, flaps, etc)*
- b. Degraded modes of operation, battle damage and/or malfunctions, to be simulated*
- c. Secondary flight control observables required to be presented to the aircrew (landing gear position, arresting hook position, flap position, etc)*

Even though loaded power levers are not considered as flight controls, the requirements for them should be addressed in this paragraph.

This paragraph should be tailored to provide a list of the active secondary controls of the application aircraft. The required accuracy of the secondary controls should be specified. FAA Circular AC 120-40 should be used to determine tolerances that will be applied to the secondary controls. If a full simulation of all secondary controls is required, any performance characteristics less than "as aircraft" should be identified.)

3.2.1.2.4 Trim Function. The trim function provides the simulation of trimming the aircraft (i.e., maintaining a desired lateral, directional, or longitudinal flight configuration without continuous control device input force).

Trim control of the aircraft shall be accomplished via trim switches and/or trim wheels in the cockpit. The surface tab positions shall be dependent upon these cockpit controls, AFCS inputs, surface tab hinge moments, hydraulic pressures, electrical power, flight condition, and malfunction data.

(The following considerations should be addressed concerning the specification of the trim system simulation, based on training requirements:

- a. *Class of air vehicle to be simulated (rotorcraft, airplane, glider balloon, etc)*
 1. *If "rotorcraft" which rotary wing methods of trim are required, cyclic, etc?*
 2. *If "airplane" which of the following trim tabs are required, ailerons, elevator, rudder, etc?*
 3. *If "airplane" which of the following trim surfaces are required, elevons, spoiler, stabilator, stabilizer, rudder, etc.?*
- b. *Degraded modes of operation, battle damage and/or malfunctions, to be simulated c.*
- c. *AFSC trim inputs required*
- d. *Trim function observables required to be presented to the aircrew (rudder trim, elevator trim, aileron trim, etc)*

This paragraph should discuss the degree of simulation required for the trim functions. Tolerances for trim rates, and resulting surface tab positions should be specified. FAA Circular AC 120-40 should be used to determine tolerances that will be applied to the trim devices. If a full simulation is required, any performance characteristics less than "as aircraft" should be identified.)

3.2.1.2.5 Hinge Moments Function. The hinge moments function determines the aerodynamic moments on the flight controls surfaces for the aircraft application.

The hinge moments shall be determined by interpolation of table look-up values for surfaces such as ailerons, elevators, rudders, flaps, spoilers, and tabs. Hinge moments shall be a function of

surface positions and aircraft flight conditions.

(The following considerations should be addressed concerning the specification of the hinge moment simulation, based on training requirements:

- a. *Class of air vehicle to be simulated, rotorcraft, airplane, glider balloon, etc*
 - 1. *If "airplane" which of the following hinge moments are required, ailerons, elevator, rudders, flaps, spoilers, canards, tabs, etc?*
 - 2. *If "rotorcraft" what hinge moments are required?*
- b. *Degraded modes of operation, battle damage and/or malfunctions, to be simulated,*

This paragraph should be tailored to identify the control surfaces for which hinge moments will be computed. The range of flight conditions for hinge moment computations should be specified.)

3.2.1.2.6 Automatic Flight Controls System Function. The AFCS function provides for the simulation of systems such as autopilot, stability augmentation, automatic approach/landing, precision course direction, terrain following and direct lift control systems.

The autopilot simulation shall provide the capabilities of heading hold, attitude hold, altitude hold, airspeed hold and Mach hold. The autopilot simulation shall utilize parametric data from the Navigation segment, Flight Station segment and IOS segment, as appropriate, in autopilot calculations.

Stability augmentation simulations shall provide improved stability in the pitch, roll and yaw axes by providing aircraft damping. When engaged, the stability augmentation system shall oppose any deviation in attitude, but shall not return the aircraft to a given attitude or heading. The simulation shall provide for stability augmentation to be engaged individually or in any combination of pitch, roll and yaw. Sensed rate signals and Central Air Data Computer (CADC) inputs shall be used in determining pitching, rolling, or yawing motion.

(The following considerations should be addressed concerning the specification of the automatic flight control system simulation, based on training requirements:

- a. *Class of air vehicle to be simulated (rotorcraft, airplane, glider, balloon, etc)*
 - 1. *If rotary wing, what AFCS Simulation is required, hover, ceiling max, etc?*
 - 2. *If "airplane" which of the following AFCS simulations are required, heading hold, attitude hold, altitude hold, airspeed hold, Mach hold, etc?*
- b. *Degraded modes of operation, battle damage and/or malfunctions, to be simulated*
- c. *AFCS function observables required to be presented to the aircrew (status lights, etc)*

The model number and manufacturer of the AFCS equipment being simulated should be noted.

This paragraph should specify the performance characteristics of the AFCS simulation including tolerances and any deviations from aircraft test data. The range of flight conditions that the AFCS should operate in should be noted. The training objectives should be considered. For instance, maintenance training may only require only a self test with little or no need for the complex control loop implementation required for the pilot training scenario.)

3.2.1.2.7 Toe Brakes and Anti-Skid Function. The toe brakes, parking brake and anti-skid function provide the simulation of braking effects during landing and ground maneuvers. A full simulation representative of brake and tire failure dynamics and decreased braking efficiency due to buildup of brake temperature shall be provided.

The toe brakes and anti-skid function shall provide the right and left wheel brake pressures as a function of the applied brake pedal force. The wheel brake simulation shall include an anti-skid system which prevents wheel skid and reduces landing roll. The simulation shall provide normal, emergency, auxiliary and parking brake simulations.

(The following considerations should be addressed concerning the specification of the toe brakes and anti-skid system simulation, based on training requirements:

- a. Brakes required left toe, right toe, parking, etc*
- b. Passive or loadable brake controls required*
- c. Anti-skid required for this application*
- d. Degraded modes of operation, battle damage and/or malfunctions, to be simulated*
- e. Toe brake and anti-skid function observables are required to be presented to the aircrew (indicator lights, etc)*

Applied force and position tolerances should be specified for toe brake application pedals. FAA Circular AC 120-40 should be used to determine tolerances that will be applied to the brakes and anti-skid functions. Tolerances for the resulting wheel brake pressures for each wheel should be specified.)

3.2.2 System Capability Relationships. The Flight Controls segment shall support the capability relationships defined in Volume I of this specification. Flight Controls functional relationships shall be as described in the following paragraphs.

(Define any Flight Controls segment unique capability relationships. In general, the capability relationships specified in Volume I will suffice for this segment.)

3.2.2.1 Segment Functional Relationships. The top level, typical Flight Controls segment functional relationships are

depicted in FIGURE 1. Each function shall operate in a manner which will allow the segment, as a system, to satisfy the timing requirements described in Volume I of this specification. Functions implemented within the Flight Controls segment shall operate in such a manner which allow the segment to meet both segment and system level requirements without degradation.

(There are two approaches to describing inter-segment interfaces: all functions communicate through the support function, or all functions communicate directly with other functions. FIGURE 1 in all segments may have the same structure. For this segment, functions which are not implemented should be shaded out. If desired, functions which are only partially implemented may be graphically represented with cross hatching. Note that the intent of this diagram should be to identify "required" internal relationships and not to specify the segments internal design. The tailoring of this paragraph should be done very carefully.)

3.2.3 External Interface Requirements. The Flight controls segment shall support the external interface requirements defined in Volume I of this specification and the _____ (insert application aircraft type) MSS Interface Requirements Specification (IRS). External interfaces comprises data passed between Flight Control segment functions and the functions of other MSS segments. With the exception of the dedicated interfaces for the cockpit, all other external interfaces which shall be used for the Flight control segment are specified in the _____ (insert application aircraft type) MSS Interface Requirements Specification (IRS).

(Define any Flight control segment unique external interface requirements. External facility interfaces for primary power, cooling, floor space, etc., should be identified here or specifically referenced in Volume I.)

3.2.4 Physical Characteristics. The physical characteristics of the Flight Controls segment shall meet the requirements as specified in Volume I of this specification. The cockpit controls and indicators associated with the flight controls system functions shall be located within the Flight Station Segment. The Flight Controls segment physical characteristics shall be of such design as to interface with the other MSS segments via the MSS VNET.

(Physical characteristics requirements for the Flight Controls segment, other than those provided by the Flight Controls segment computational system and its interface to the MSS VNET shall be defined in this paragraph. Physical characteristic requirements may include backdoor interface hardware to connect Flight Controls segment (I/O) to the MSS. In addition, any weight or size considerations applicable to the Flight Controls segment should be considered.

This paragraph should be tailored to provide a complete list of all active cockpit controls and indicators associated with the primary and/or secondary flight controls, trim system, AFCS, and

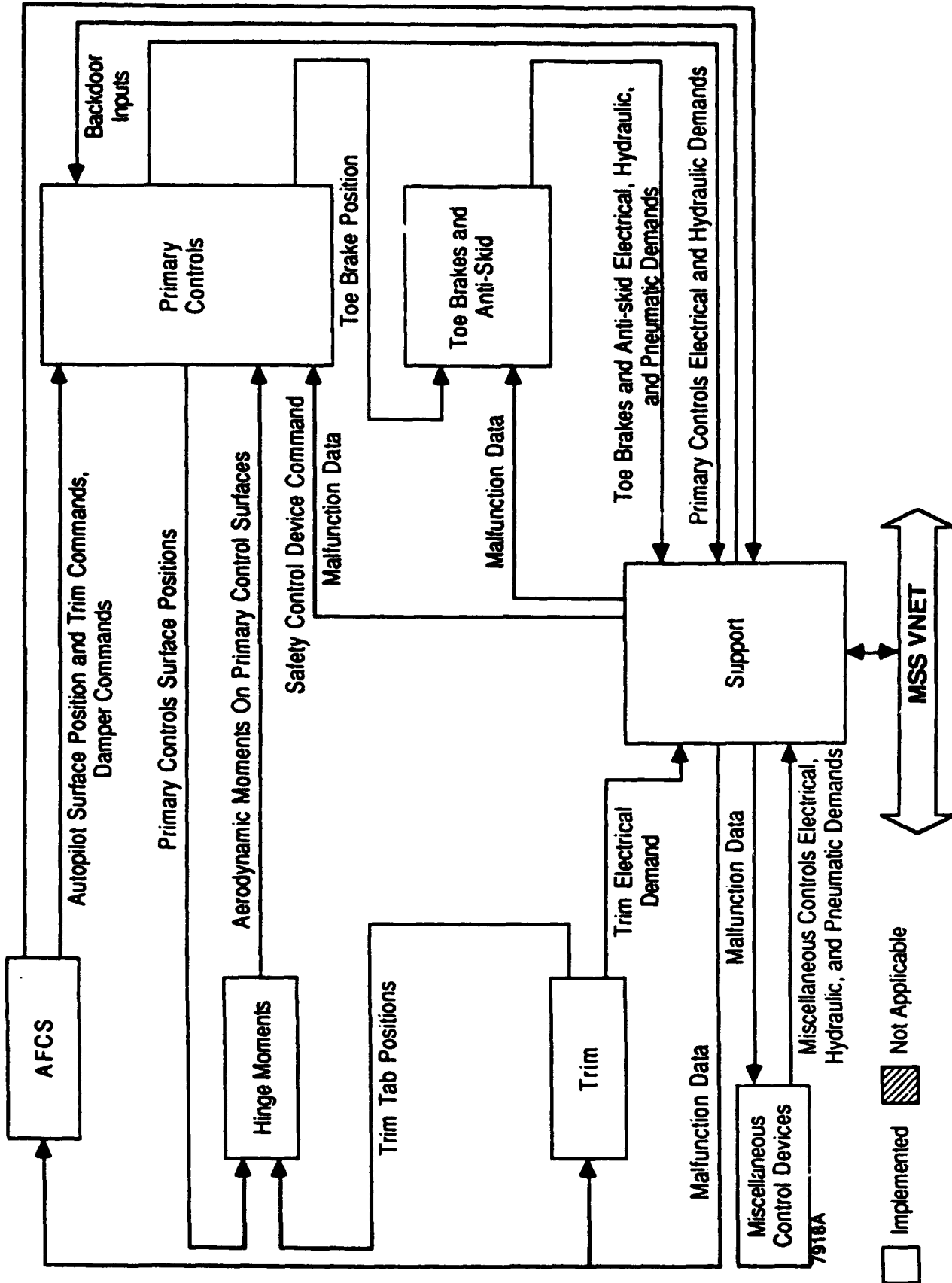


FIGURE 1 FLIGHT CONTROLS SEGMENT FUNCTIONAL RELATIONSHIPS

toe brake/anti-skid functions. For high fidelity training systems, actual aircraft control devices (joystick, cyclic and collective sticks, etc.) may be required. Non-operable controls and/or indicators should be identified as a mock-up, actual aircraft dummy, photo, etc. Additionally, consideration must be given to the need for hydraulic pumps and the possibility of sharing hydraulic pressure requirements with the motion function of the Physical Cues segment. Due to the high frequency response required to control the position and forces applied to the input devices, the control loading system may be handled by special purpose hardware. Any special purpose control loading hardware requiring high frequency control shall be directly connected to the Flight Controls segment and its physical characteristic requirements identified here.

3.2.4.1 Protective Coatings. Flight Controls segment protective coatings shall be as defined in Volume I of this specification.

(Additional protective coating requirements which are required for the Flight Controls segment may be defined in this paragraph. In general, the requirements of Volume I should suffice for the entire system.)

3.2.5 Flight Controls Segment Quality Factors

3.2.5.1 Reliability. The system level reliability requirements applicable to all segments in the MSS are defined in Volume I of this specification. The Flight Control segment reliability must be _____ % to satisfy the system level reliability requirements. The Mean Time Between Critical Failure (MTBCF) shall not be less than _____ hrs.

(A specific allocation of reliability (e.g. MTBCF) for this segment should be specified in this paragraph. Reliability should be allocated to each segment in such a way that system level reliability requirements will be met. Normally this means that segment reliability will be higher than system reliability.)

3.2.5.2 Maintainability. The system level maintainability requirements applicable to all segments in the MSS are defined in Volume I of this specification. The Flight Controls segment shall have a mean corrective maintenance time, of _____ minutes, and a 90th percentile maximum corrective maintenance time of _____ minutes to satisfy the system level maintainability requirements.

(Maintainability requirements such as Mean Time to Repair (MTTR) should be allocated to each segment in such a way that system level maintainability requirements will be met. Normally this means that segment MTTR will be higher than system MTTR. System level requirements will include isolation to a faulty segment.)

3.2.5.3 Availability. The system level availability requirements applicable to all segments in the MSS shall be as defined in Volume I of this specification.

(Usually, availability applies only to the system level. Reliability and Maintainability (MTBF and MTTR) should be allocated to each segment in such a way that system availability requirements will be met. It would be unusual to impose an availability requirement at the segment level.)

3.2.5.4 Additional Quality Factors. The additional quality factors, as defined in Volume I of this specification, shall apply to Flight Controls segment.

(Additional Flight Controls segment unique quality factors may be defined in this paragraph. In general, the system level additional quality factors will suffice for the Flight Controls segment.)

3.2.6 Environmental Conditions. The environmental conditions requirements, as defined in Volume I of this specification, shall apply to Flight Controls segment.

(Identify any Flight Controls segment unique environmental requirements. In general, the system level environmental conditions will suffice for the Flight Controls segment.)

3.2.7 Transportability. The transportability requirements, as defined in Volume I of this specification, shall apply to Flight Controls segment.

(Identify any Flight Controls segment unique transportation requirements, such as self contained hydraulic pumps, hydraulic plumbing, provisions for installation of rigging pins in flight control loaders, etc that will prevent damage to Control Loading segment hardware during transportation. There may exist unique transportation requirements to ship the segment from the segment contractors facility to the prime contractors facility. In general, the system level transportability requirements will suffice for the Flight Controls segment.)

3.2.8 Flexibility and Expansion. The flexibility and expansion requirements, defined in Volume I of this specification, shall apply to the Flight Controls segment.

(Unique requirements for this segment may include spare memory, spare time, spare mass storage, I/O channels by type, chassis expansion slots, etc. Expansion requirements should consider the likelihood that this segment will need to change as well as the cost of including capability now versus cost to change later. Reuse of the segment in future applications should also be considered and specified.)

3.2.9 Portability. The portability requirements, defined in Volume I of this specification, shall apply to the Flight Controls segment.

(Except for field transportable trainers, portability of hardware is usually not a requirement. Portability of software may be a concern for future changes which may include upgrading the Computer Hardware Configuration Item (HWCI) are considered likely. Use of a standard

higher order language such as Ada is usually adequate to assure software portability.)

3.3 Design and Construction. The design and construction requirements, defined in Volume I of this specification, shall apply to the Flight Controls segment.

(Identify any Flight Controls segment unique design and construction requirements. In general, the system level design and construction requirements will suffice for the Flight Controls segment.)

3.3.1 Materials. The materials requirements, defined in Volume I of this specification, shall apply to the Flight Controls segment.

(Identify any Flight Controls segment unique materials requirements. In general, the system level materials requirements will suffice for the Flight Controls segment.)

3.3.1.1 Toxic Materials. The toxic materials requirements, defined in Volume I of this specification, shall apply to the Flight Controls segment.

(Identify any Flight Controls segment unique toxic materials (i.e. hydraulic fluid) requirements. In general, the system level toxic materials requirements will suffice for the Flight Controls segment.)

3.3.2 Electromagnetic Radiation. The electromagnetic radiation requirements, defined in Volume I of this specification, shall apply to the Flight Controls segment.

(Identify any Flight Controls segment unique electromagnetic radiation requirements. In general, the system level electromagnetic radiation requirements will suffice for the Flight Controls segment.)

3.3.3 Nameplates and Product Marking. The nameplate and product marking requirements, defined in Volume I of this specification, shall apply to the Flight Controls segment.

(Identify any Flight Controls segment unique nameplate and product marking requirements. In general, the system level nameplate and product marking requirements will suffice for the Flight Controls segment.)

3.3.4 Workmanship. The workmanship requirements, defined in Volume I of this specification, shall apply to the Flight Controls segment.

(Identify any Flight Controls segment unique workmanship requirements. In general, the system level workmanship requirements will suffice for the Flight Controls segment.)

3.3.5 Interchangeability. The interchangeability requirements, defined in Volume I of this specification, shall apply to the Flight Controls segment.

(Identify any Flight Controls segment unique interchangeability requirements. In general, the system level interchangeability requirements will suffice for the Flight Controls segment.)

3.3.6 Safety. As a minimum the following safety features will be a part of the design for the _____ *(insert application aircraft type)* MSS Flight Control segment.

- a. The Flight Control segment shall be designed to minimize and control health and safety hazards to personnel using or maintaining the Flight Control segment hardware, either during training or maintenance.
- b. The Flight Control segment shall conform to the health and safety requirements of MIL-STD-454 and MIL-STD-1472, and best commercial practices.
- c. At no time shall the flight control hardware move unexpectedly. "Freezing" or release from a simulator "freeze" condition shall not result in rapid flight control hardware movement.
- d. Engagement and/or disengagement of the flight controls shall not result in abrupt flight control hardware movement.
- e. Abrupt flight control hardware movement shall not occur when power subsystem components are deactivated unexpectedly, nor if line power failure or fluctuation occurs.

In addition the safety requirements, defined in Volume I of this specification, shall apply to the Flight Controls segment.

(If the MSS employs a motion system a provision should be included in the Flight Control segment to disengage the motion system if the Flight Control segment becomes inoperable for any reason.

If the Flight Control segment employs a hydraulic control loading system the following considerations should be addressed.

- a. A Flight Control engage consent switch, in the area of the control loading loaders may be required to prevent the control loading from being engaged while maintenance is being performed.
- b. Hydraulic warning switches could be supplied and so designed so as to cause an emergency shutdown of the control loading system: hydraulic fluid over-pressure

switch, hydraulic over temperature switch and hydraulic fluid low level switch.

Additionally identify any Flight Control segment unique safety requirements. In general, the system level safety requirements will suffice for the Flight Controls segment.)

3.3.7 Human Engineering. The human engineering requirements, defined in Volume I of this specification, shall apply to the Flight Controls segment.

(Identify any Flight Controls segment unique human engineering requirements. In general, the system level human engineering requirements will suffice for the Flight Controls segment.)

3.3.8 Nuclear Control. The nuclear control requirements, defined in Volume I of this specification, shall apply to the Flight Controls segment.

(Identify any Flight Controls segment unique nuclear control requirements. In general, the system level nuclear control requirements will suffice for the Flight Controls segment.)

3.3.9 System Security. The system security requirements, defined in Volume I of this specification, shall apply to the Flight Controls segment.

(Identify any Flight Controls segment unique system security requirements. In general, the system level system security requirements will suffice for the Flight Controls segment.)

3.3.10 Government Furnished Property. Government Furnished Property (GFP) shall be as identified in Volume I of this specification.

(Identify any Flight Controls segment unique GFP requirements. In general, the system level GFP requirements will suffice for the Flight Controls segment.)

3.3.11 Computer Resource Reserve Capacity. The system level reserve capacity requirements applicable to all segments in the MSS are defined in Volume I of this specification.

(In addition to the computer resource reserve capacity identified in volume I, the specific reserve capacity for the Flight Controls segment may include the computational system hardware and software required to design, develop, and test the Flight Controls segment. System considerations such as spare (time, memory, storage, I/O channels) for growth unique to this segment should be imposed here. If this paragraph requires subparagraphs they should follow the numbering and topics used in Volume I.)

3.4 Documentation. The documentation requirements, defined in Volume I of this specification, shall apply to the Flight Controls segment.

(Identify any Flight Controls segment unique documentation requirements. Documentation requirements for the Flight Controls segment may include interface specifications, design data for interfacing to an embedded piece of flight controls equipment and/or vendor data. Data provided by control loading hardware/software vendors could be submitted using best commercial documentation practices. In general, the system level documentation requirements will suffice for the Flight Controls segment.)

3.5 Logistics. The systems level logistics requirements for the Flight Controls segment shall be as specified in Volume I of this specification, paragraph 3.5, and all subparagraphs of paragraph 3.5.

(Unique support requirements for this segment should be described here. These may include special tools and jigs for installation, alignment and calibration; special environmental conditions for operation and repair such as a clean-room for component repairs; levels and types of spares required; number, skills and training for maintenance personnel.)

3.6 Personnel and Training. The system level personnel and training requirements, defined in Volume I of this specification, shall apply to the Flight Controls segment.

(Identify any Flight Controls segment unique personnel and training requirements. In general, the system level personnel and training requirements will suffice for the Flight Controls segment.)

3.7 Subordinate Element Characteristics. Not Applicable.

(This volume defines requirements for a subordinate element of the MSS. In general, there will be no subordinate elements of a segment.)

3.8 Precedence. The precedence requirements for the Flight Controls segment shall be as specified in Volume I of this specification.

4. QUALIFICATION REQUIREMENTS

4.1 Responsibility For Test and Inspection. The _____ (insert application aircraft type) MSS responsibility For test and inspection requirements are defined in Volume I of this specification. The requirements defined in Volume I shall apply to the Flight Control segment.

(This paragraph may be tailored to identify additional test or inspection requirements which are specific to the Flight Control Segment.)

4.2 Special Tests and Examinations. The system level general qualification events, levels, and methods of testing for the Flight Controls segment are defined in Volume I of this specification. The requirements defined in Volume I shall apply to the Flight Controls segment.

(Clearly identify which test events defined in Volume I apply to this segment. Be particularly explicit about the segment builder's responsibility during system integration and test. However, in some cases, verification can only be achieved in the integrated mode. A clear definition of the segment supplier's responsibility during systems integration should be contained in the SOW.

This paragraph may be tailored to identify additional test or inspection requirements which are specific to the Flight Control segment. The following list contains examples of special tests that may be required depending on the application aircraft specific verification requirements.

- a. *Flight Dynamics, Flight Controls, and Propulsion Segments Subjective Integrated Tests: Although thorough and complete design data will reduce the amount of subjective tuning and testing that may be required, a subjective test to confirm proper integration of the Flight Dynamics, Flight Controls and Propulsion systems will still be required.*
- b. *Autotests: These tests are initiated from the IOS for the purpose of segment and integrated performance testing. Autotests provides repeatable results in a much shorter period of time than pilot in the loop tests. This may be for acceptance testing or simulator certification. The types and extent of test to be included will be driven by the support concept and availability requirements of the system and their allocation to this segment. Autotest may be used for acceptance by the procurement agency and certification by the user or FAA (SIMCERT/AC120-40). Consideration must also be given whether or not design criteria only or design criteria plus subjective tuning will be used when determining pass/fail criteria for autotest.*

Responsibility for integrated tests should be minimized at the segment level. If the segment is required to pass an integrated test, as part of its acceptance, that test(s) should be called out here. Additional tests might include segment compliance tests which can only be performed with the segment installed as part of a system. These should be identified here and the requirements

detailed by adding subparagraphs.)

4.3 Requirements Cross Reference. A requirements compliance cross reference matrix shall be developed to ensure requirement traceability. The requirements cross reference matrix shall be included as part of the _____ MSS Prime Item Development Specification (PIDS).

5. PREPARATION FOR DELIVERY. The _____ (*insert application aircraft type*) MSS preparation for delivery requirements, as defined in Volume I of this specification, shall apply to the Flight Controls segment.

(Segment unique requirements may include packaging the segment for shipment to the integration location which could be different than packaging the system for shipment to the installation site. If requirements are imposed here, there may be test requirements for verification which must be added to Section 4.)

6. NOTES

6.1 Intended Use. The _____ (insert application aircraft type) MSS shall be used as an integral part of the _____ (insert application aircraft type) aircraft training system.

6.1.1 Missions. The Flight Controls segment shall support the mission requirements, as described in paragraph 6.1.1 of Volume I of this specification. It shall provide the Flight Controls portion of simulation and training in cockpit familiarization, flight characteristics, operating procedures, and mission procedures for the _____ (insert application aircraft type) MSS. The Flight Controls simulation shall assist in allowing the trainee to become familiar with the cockpit configuration and flight characteristics of the aircraft, gain proficiency in executing normal procedures, in recognizing malfunctions/abnormal indications and executing the corresponding emergency procedures, and in executing mission procedures. Normal procedures and emergency procedures specified herein shall be taken from the aircraft Technical Orders (T.O.s) for the _____ (insert application aircraft type). The trainees may range in experience from newly designated aviators undergoing initial training to experienced aviators undergoing refresher training.

(The Flight Controls segment mission is to support the trainer mission as described in Volume I. Any mission specific information should be described in this section. An example would be a segment intended to support a family of trainers such as a procedures trainer, part-task trainer, flight trainer, or weapons system trainer.)

6.1.2 Threat. Not applicable.

(This paragraph shall describe the threat which the system is intended to neutralize. In this context, this paragraph is not applicable to most simulators, and will generally remain "Not applicable".)

6.2 Flight Controls Segment Acronyms. The acronyms contained in this paragraph are unique to the Flight Controls segment and are in addition to the MSS acronyms contained in Volume I of this specification, paragraph 6.1.

AFCS	Automatic Flight Control System
CADC	Central Air Data Computer
CPT	Cockpit Procedures Trainer
DOD	Department of Defense
GFP	Government Furnished Property
H/W	Hardware

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IDD	Interface Design Document
IOS	Instructor Operator Station
I/O	Input/Output
IRS	Interface Requirements Specification
MSS	Modular Simulator System
MT	Maintenance Trainer
MTBCF	Mean Time Between Critical Failure
N/A	Not Applicable
TBD	To Be Determined
T.O.s	Technical Orders
VNET	Virtual Network
WST	Weapon System Trainer

6.3 Glossary of Flight Controls Segment Terms. The terms contained in this paragraph are unique to the Flight Controls segment and are in addition to the MSS terms contained in Volume I of this specification, paragraph 6.2.

AIR VEHICLE - The aircraft being simulated for training purposes.

ANTI-SKID - Aircraft system which prevents wheel skid during brake application thus reduces landing roll. Used primarily during aircraft landing.

AUTOMATIC FLIGHT CONTROL SYSTEM - Aircraft system capable of automatically controlling the flight path of the aircraft.

COCKPIT PROCEDURES TRAINER - This type of trainer is typically a faithful representation of the cockpit with all air vehicle system simulated but without motion or visual systems and without a flying capability. The purpose of a CPT is to teach location of air vehicle controls and displays and basic air vehicle operation and procedures. The functionality of a CPT can vary depending upon the training requirements of the device.

CONTROL DEVICES - Aircraft components utilized by flight control systems to guide and direct the aircraft's flight path.

CONTROL LOADING - The process of computing actual physical forces to be applied on the ownship's controls to realistically simulate the resistance to movement of those controls.

CONTROL LOADING SYSTEM - A system used to induce synthetic loads on the Air Vehicle Training System's controls to produce force and feel characteristics similar to the actual control system of the application air vehicle.

CONTROL SURFACES - Any flight control which functions by inserting a surface into the air stream surrounding the aircraft. Example include: flaps, spoilers, speed brakes, canard and ride control vanes, ailerons, etc.

FLIGHT CONTROLS SEGMENT - Provides the simulation of the control surfaces and air vehicle control devices/systems for the application air vehicle. This segment includes the simulation of primary controls (flaps, control columns, elevators, ailerons, rudders, rotor blades, tail rotors, propellers), secondary control devices (landing gear, external doors, toe brakes, anti-skid systems), automatic flight control/autopilot systems and air vehicle trim systems. The primary function of the flight controls is to enable flight path guidance.

FLIGHT DYNAMICS SEGMENT - Provides the simulation of the aerodynamic qualities of the application air vehicle. the flight dynamics segment also simulates the air vehicle's structural limitations based on aerodynamic flight envelope violation and external crash conditions.

FLY-BY-WIRE - Mechanization in which pilot-initiated control inputs are transmitted via electrical signals rather than mechanical linkage.

HINGE MOMENTS - Aerodynamic force on control surface due to present aircraft state. Hinge moments oppose effect of control surface actuators.

INSTRUCTOR/OPERATOR STATION - Provides the central point of control for the entire air vehicle trainer. The primary user of the IOS is the training instructor. Secondary users may consist of students and maintenance technicians. The IOS segment provides the capabilities for simulator status and control, controls disagreement and crew (trainee) performance monitoring and measurement. Simulator status and control capabilities will include ownship, navigation/communication, environment, and missions. The IOS may be responsible for the control and monitoring of either one or many simulation devices depending on the specific application.

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OPERATIONAL FLIGHT TRAINER - A training device that is designed to provide instruction in the operation and flight of an air vehicle.

PRIMARY CONTROLS - Those controls which provide the major portion of control capability in operating the aircraft. These controls may consist of ailerons, rudders, elevators, canards, wing camber, swash plates and rotor blades.

SECONDARY CONTROL DEVICES - Those aircraft systems which provide additional guidance control, and other non-guidance control aircraft systems which involve exterior movable components. Additional guidance controls include: flaps, slats, spoilers, speed brakes, canard and ride control vanes, and variable wing sweep. Non-guidance control exterior components may include: landing gear, ram air turbines, arresting hooks and aircraft doors.

STABILITY AUGMENTATION SYSTEMS - This system provides stability about all axis at all airspeeds by transferring control inputs and aircraft motion into control surface displacement to produce damping, maneuver control and trim.

TOE BRAKES AND ANTI-SKID - An aircraft system that provides the ability to slow the aircraft while on the ground. Anti-Skid is an enhancement to the aircraft braking system which prevents over application of the brakes, thus leading to wheel lock and thereby inefficient braking.

TRIM - The process of establishing or maintaining lateral, directional and/or longitudinal equilibrium in flight.

WEAPON SYSTEM TRAINER - A training device that is designed to provide instruction in the operation of all weapon systems of a particular air vehicle.

VECTORED THRUST - An aircraft system for effective guidance control by changing the flow pattern of engine exhaust.

ACTIVE PAGE RECORD											
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		PAGE NO.	REV LTR	PAGE NO.	REV LTR			PAGE NO.	REV LTR	PAGE NO.	REV LTR
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REVISIONS			
LTR	DESCRIPTION	DATE	APPROVAL
A	BMAC-STS-86-303-1 Total revision required to incorporate changes required by testing/validation efforts and Government comments.	90/01/11	L. Clem
			Prepared By
		90/01/11	SM Hunter
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B	CCP HSV-H91-008 Total revision required to incorporate changes resulting from addition of two new specifications and new functional allocation. Damage Assessment and Scoring were added to the module support function.	90/01/11	SM Hunter
			Supervised By
		91/01/15	WV Tucker
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		91/06/26	L. Stuckey
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C	CCP HSV-H91-008 Total revision required to incorporate Government comments on document.	91-09-26	K. Kelly Prepared By												
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		91-09-26	S.M. Hunter Supervised By												
		91-10-08	M.V. Tucker Approved By												
D	CCP HSV-H91-017 This specification volume has been totally revised to: 1. Change the format to comply with DI-CMAN-80008A. 2. Incorporate the tailoring instructions into the body of the text. The incorporation of tailoring instructions into each specification volume has caused a change in the number of specification volumes from fourteen to thirteen. Prior to this change, all tailoring instructions were provided in Volume XIII and Volume XIV contained the Tactical and Natural Environment segment specification. The content of Volume XIII has been integrated into the other specification volumes. The change is summarized as follows: <table border="0"> <tr> <td><u>Volume</u></td> <td><u>IS</u></td> <td><u>WAS</u></td> </tr> <tr> <td>I through XII</td> <td colspan="2">Titles for these volumes are unchanged</td> </tr> <tr> <td>XIII</td> <td>Environment</td> <td>Tailoring Instructions</td> </tr> <tr> <td>XIV</td> <td>"Deleted"</td> <td>Tactical and Natural Environment</td> </tr> </table>	<u>Volume</u>	<u>IS</u>	<u>WAS</u>	I through XII	Titles for these volumes are unchanged		XIII	Environment	Tailoring Instructions	XIV	"Deleted"	Tactical and Natural Environment	93-08-23 PREPARED	J.P. Arnold CHECKED
<u>Volume</u>	<u>IS</u>	<u>WAS</u>													
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		93-08-23	S.M. Hunter SUPERVISED												
		93-08-25	S.M. Hunter APPROVED												

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EPH: JmL/epg/ltt 93-08-26

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